UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/780,025	02/17/2004	Wenbin Gu	8540G-000187	9272

27572 7590 07/11/2007
HARNESS, DICKEY & PIERCE, P.L.C.
P.O. BOX 828
BLOOMFIELD HILLS, MI 48303

EXAMINER	
WALKER, KEITH D	
ART UNIT	**PAPER NUMBER**
1745	

MAIL DATE	DELIVERY MODE
07/11/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

UNITED STATES PATENT AND TRADEMARK OFFICE

Commissioner for Patents
United States Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-1450
www.uspto.gov

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

MAILED
JUL 1 1 2007
GROUP 1700

Application Number: 10/780,025
Filing Date: February 17, 2004
Appellant(s): GU ET AL.

Jennifer M. Woodside Wojtala
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed February 28, 2007 appealing from the Office action mailed August 24, 2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

2003/0235735	MIYAZAWA ET AL.	12-2003
5,432,023	YAMADA ET AL.	7-1995
2002/0001743	DAVIS	1-2002

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-3, 5-12, 15-21 & 23 are rejected under 35 U.S.C. 103(a) as being unpatentable over US Publication 2003/0235735 (Miyazawa) in view of US Patent 5,432,023 (Yamada).

Miyazawa teaches an electrochemical cell having: a membrane electrode assembly (MEA) comprising an anode and cathode (Figure 1, #20); an electroconductive element comprising an impermeable electrically conductive element (ECE) having a major surface facing the cathode (Figure 1, #4b) and a porous liquid distribution media (LDM) disposed along the major surface defining flow channels for transporting gas and liquid to and from the cathode (Figure 2, #14). An electrically

conductive fluid distribution layer (FDL) is disposed between the liquid distribution media and the cathode for transporting gases and liquids between the cathode and the flow channels (Figure 1, #21b). The FDL and LDM are constructed and arranged to transport liquids accumulating within the cathode through the FDL to the LDM. The ECE and LDM are arranged together to define the flow channels. The LDM forms an electrically conductive path between the ECE and FDL. The LDM is more hydrophilic than the FDL, overlies substantially the entire major surface of the ECE, and is disposed in regions along the major surface defining separate spaced-apart flow channels. The LDM has an undulated configuration of peaks and valleys and internally redistributes liquid water. The electroconductive element also comprises a second ECE having a second surface facing the anode, a second LDM along regions of the second surface, and a second FDL disposed between the electroconductive element and anode and in contact with the second LDM. The LDM is composed of a conductive hydrophilic material, for example carbon black. The porous fluid distribution layer (FDL) is in physical contact and fluid communication with an electrode and the porous LDM layer is more hydrophilic than the FDL and draws water from the electrode through the FDL (Page 2, [0018]–[0029]; Page 3, [0033], [0036], [0037]; Page 5, [0056], [0057]).

Miyazawa is silent to the size of the pores for the fluid distribution layer and the liquid distribution layer.

Yamada also teaches a fuel cell system with an impermeable metal separator and layers of conductive porous material with differing pore sizes (10:40-60, 16:25-40). Having materials with two different pore sizes pulls the liquid in the direction of the

smaller pores. By varying the pore diameter, the rate or force with which the liquids are drawn in the direction of decreasing pore diameter can be changed. With respect to the cathode, the conductive porous material next to the cathode will have a pore diameter larger than the porous material next to the separator so the water is pulled away from the cathode (39:2-27). The pore sizes dictate what liquid or gas is passed through the structure and which direction the liquid or gas passes (24:14-20, 39:5-10). The size of the pores is dependent on the material used as the porous layer and the type of fluid to be transported by the pores. Yamada teaches pore sizes of 30 microns and a formula, such that the pore sizes can be varied to optimize factors such as the fluid travel speed and the fluid volume transported (39:15-50). A nickel mesh is used for the conductive material (47:35-45).

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the porous layers of Miyazawa with the pore size structures taught by Yamada to improve the efficiency of the fuel cell by pulling the by-product waste, such as water, away from the electrodes to produce a more efficient fuel cell. The pore sizes can be adjusted for the material used, the application and the force with which the fluid will be withdrawn from the electrode material by applying the formula taught (39:30-40).

Regarding claim 12, Miyazawa is silent to the LDM layer comprising two layers.

As stated above, Yamada teaches a method of removing water from the cathode using capillary action. The method involves joining multiple porous layers together so the pores in each layer are smaller than the pores in the previous layer, thereby pulling

the water away from the cathode through each adjoining layer (9:60-10:20, 10:39-60). By using multiple layers with different pore sizes, the rate or force with which the water is drawn from the cathode can be varied (39:2-27). So Yamada teaches that multiple porous layers can be used to draw water away from the cathode by stacking the layers such that each consecutive layer has smaller pores.

Therefore it would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the single porous layer of Miyazawa with the multiple porous layers of Yamada to quickly and efficiently draw the water away from the cathode. Furthermore, it would be obvious to one of ordinary skill in the at the time of the invention to separate a porous layer into two layers, since it has been held that constructing a formerly integral structure into various elements involves only routine skill in the art (MPEP 2144.04).

Regarding claims 17, 19, 21 & 23, these claims are seen as product-by-process limitations and even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. "The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process" (MPEP 2113). While these limitations have been considered, they have not been given patentable weight. The final product as taught by Miyazawa and Yamada as discussed above is considered obvious over the product of the instant application.

Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Miyazawa et al. (US 2003/0235735) and US Patent 5,432,023 (Yamada), as applied to claim 1 above, further in view of Davis (US 2002/0001743).

Miyazawa and Yamada teach the elements of claim 1 as discussed above but fail to teach the impermeable electrically conductive element formed of Al, Ti, stainless steel, or alloys or mixtures thereof.

Davis teaches that forming bipolar plates using metals with high electrical and thermal conductivity, such as Al, Cu, and Ti, results in plates with electrical conductivity 500 times better and thermal conductivity double that of graphite. This can reduce the effect of localized heating due to areas of localized high current density and voltage drop, such as membrane dry-out (Page 2, [0007], [0008]).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made would have used a bipolar plate made of Al or Ti as taught by Davis in the electrochemical cell as taught by Miyazawa and Yamada in order to reduce localized heating caused by areas of high current density and large voltage drop.

(10) Response to Argument

Appellant's claimed invention is drawn to an electrochemical cell (i.e. fuel cell) that produces electricity by reacting a fuel (e.g. hydrogen) with an anode electrode and an oxidant (e.g. air) with a cathode electrode. A separator (appellant's impermeable electrically conductive element) is a well known element used to electrically connect

multiple fuel cells together and is used to facilitate the distribution of the reactants (fuel and oxidant) to the respective electrodes. A gas diffusion layer (GDL) is another well known element located between the separator and the electrode. The GDL is a porous element that acts, as the name implies, to diffuse the reactant gas to the electrode. Dispersing the gas across the electrode surface increases the number of interactions between the reactant gas and the catalyst in the electrode, thereby improving the amount of power produced by the fuel cell. Appellant has taken the well known GDL and made it into two separate layers, the fluid distribution layer (FDL) and the liquid distribution media (LDM). These two layers still allow the reactant to pass through from the separator to the electrode and also allows liquid (water) formed at the cathode to pass back to the separator. The removal of excess water from the electrode is important to the efficient operation of the fuel cell and is also well known in the art. If an electrode retains too much water, the reaction between the gas and the catalyst is inhibited. So, water is removed from the electrode layer through the GDL. In summary and as will be discussed below, appellant's claimed invention is a well known combination of well known components.

Concerning all the arguments presented by appellant, appellant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986).

A. Regarding Appellant's arguments of independent claim 1, appellant argues the modification of Miyazawa with the teachings of Yamada would render the Yamada reference inoperable. However, the rejection presented over the claimed invention is based on the teachings of Miyazawa in view of the teachings of Yamada. Elements appellant argues are not taught by the Yamada reference, such as the use of porous material inside the active regions of the fuel cell, the electrical conductivity of said porous materials and the bifurcating porous layers, are already taught by the Miyazawa reference as discussed in the previous office actions and restated in the arguments below. The Yamada reference is used to teach the sizes of the pores for the two layers. Yamada teaches using capillary action and porous materials to supply the electrodes with reactants and remove waste products (i.e., water) from the electrodes. With respect to the cathode electrode, Yamada teaches locating two porous layers next to the cathode and the pore sizes of the layers are varied from a larger size to a smaller size in the direction the liquid is desired to travel (i.e. away from the cathode) (9:67-10:17, 10:39-59).

As stated above, appellant's allegation that the "proposed modification to make the LDM conductive would render Yamada inoperable for its intended purpose" (page 7 of Brief) is not the basis of the rejection. The modification presented in the rejection was not to make the 'LDM' of Yamada conductive but to provide insight as to what size to make the pores of the porous material already taught by Miyazawa.

Appellant argues Yamada teaches away from the combination with Miyazawa, since "it has no suggestion to use any particular porous materials inside the active

regions of the fuel cell that transport gases and liquids concurrently." (Page 6 of brief). First, Miyazawa already teaches using "particular porous materials inside the active regions of the fuel cell that transport gases and liquids concurrently." Second, the Yamada reference teaches a fuel cell using capillary action to supply reactants to all elements of the fuel cell and remove unwanted products, such as water, from the cathode (Abstract). Yamada teaches in figure 1, "the fuel electrode (2) and the oxidizing electrode (3) are both formed of a conductive porous material so as to permit flow there through of the fuel and oxidizing gas" (Fig.1; 15:18-22). The porous cathode and other porous layers are constructed such that the effect is "the removal of the water formed on the oxidizing electrode" (10:46-47). Each layer has a different porosity such that the pore size decreases in size in the direction the water is to travel (9:67-10:17, 10:39-59). Therefore, Yamada does teach particular pore sizes for the porous material in the active region of the fuel cell. The limitation is rendered obvious over the teachings of Miyazawa and Yamada.

Appellant argues Yamada does not suggest, "bifurcating porous layers into an LDM and FDL, which each handle both liquids and gases." As discussed above, Miyazawa already teaches that limitation and the Yamada reference teaches how to make the porosity of the two layers pull water away from the cathode layer for more efficient operation of the fuel cell. So the combined teachings of Miyazawa in view of Yamada teach a fuel cell with two porous layers that are equivalent in structure and perform the same operation as appellant's claimed porous layers. Therefore, the

appellant's claimed porous layers are obvious over the teachings of Miyazawa and Yamada.

Appellant alleges, "Miyazawa is silent with regard to electrical conductivity". In paragraphs [0019 & 0057], Miyazawa teaches the gas diffusion layer (appellant's FDL) is made of a carbon material (conductive) and in paragraph [0036] the hydrophilic layer (appellant's LDM) has electrical-conductive properties. So Miyazawa does teach two porous electrically conductive layers.

B. Appellant argues the combination of references does not teach an electrically conductive path through the liquid distribution media (LDM) as recited in claim 3.

Miyazawa teaches coating an electrically conductive hydrophilic layer on the electrically conductive separator ([0036]). The hydrophilic layer is then removed from the very top surface of the separator's protrusions so the hydrophilic layer is left on the sidewalls and bottom surface of the separator (Fig. 2). When this top layer is removed, the edge portion of the hydrophilic layer on the sidewalls is even with the top surface of the separator. When the fuel cell is assembled and the gas distribution layer (appellant's FDL) is set on top of the separator, this edge portion of the hydrophilic layer on the sidewall will contact the FDL, thereby making both a fluid and electrical connection. Miyazawa discusses this process in paragraphs [0035-0042].

Appellant's arguments against the Yamada reference are not pertinent since two electrically conductive porous layers are already taught by the Miyazawa reference. As

discussed above, the Yamada reference teaches how to make multiple layers have different pore sizes such that the water is pulled away from the cathode.

C. Applicant argues neither reference teaches a liquid distribution media (LDM) overlying substantially all the major surface of the electrically conductive impermeable element of claim 6.

Miyazawa teaches covering at least three quarters of the surface of the separator (electrically conductive impermeable element) (Fig. 2). Since no definition or criticality is given as to what constitutes "substantially all the major surface", the at least three quarter coverage taught by Miyazawa renders obvious this limitation.

D. Appellant argues the references do not teach a LDM forming an undulating surface as recited in claim 8.

The prior art of Miyazawa teaches a hydrophilic layer (LDM) that follows the undulating surface of the separator plate that it coats. Therefore, the hydrophilic layer (LDM) also has an undulating surface. The claim limitation does not require the top of the separator lands to be covered. The limitation states the LDM "has an undulated configuration of peaks and valleys, wherein said peaks correspond to lands and said valleys correspond to grooves", as such the peak of the hydrophilic layer goes up the side of the land and meets the top of the land and therefore corresponds to the land and the valley of the hydrophilic layer is in the groove and therefore corresponds to the groove. The teachings of Miyazawa and Yamada render obvious the claimed invention.

E. Appellant argues the cited references fail to support the liquid distribution layer comprising two distinct layers.

As discussed in the above rejection of claim 12, Yamada does teach using two layers having different pore sizes to pull the water away from the cathode. By using different layers with different pore sizes, the rate at which the water is drawn from the previous layer can be varied (9:60-10:20, 10:39-60, 39:2-27). Furthermore, the separation of an integral component into separate components would be obvious to one of ordinary skill in the art at the time of the invention.

F. Appellant argues claim 22 is not rendered obvious by the combination of Miyazawa in view of Yamada and further in view of Davis, for the same reasons set forth above in the context of claim 1. As such, the remarks to the arguments of claim 1 are incorporated herein. Therefore, the teachings of the prior art render obvious the claimed invention of claim 22.

(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

This examiner's answer contains a new ground of rejection set forth in section **(9)** above. Accordingly, appellant must within **TWO MONTHS** from the date of this answer exercise one of the following two options to avoid *sua sponte* **dismissal of the appeal** as to the claims subject to the new ground of rejection:

(1) **Reopen prosecution.** Request that prosecution be reopened before the primary examiner by filing a reply under 37 CFR 1.111 with or without amendment, affidavit or other evidence. Any amendment, affidavit or other evidence must be relevant to the new grounds of rejection. A request that complies with 37 CFR 41.39(b)(1) will be entered and considered. Any request that prosecution be reopened will be treated as a request to withdraw the appeal.

(2) **Maintain appeal.** Request that the appeal be maintained by filing a reply brief as set forth in 37 CFR 41.41. Such a reply brief must address each new ground of rejection as set forth in 37 CFR 41.37(c)(1)(vii) and should be in compliance with the other requirements of 37 CFR 41.37(c). If a reply brief filed pursuant to 37 CFR 41.39(b)(2) is accompanied by any amendment, affidavit or other evidence, it shall be treated as a request that prosecution be reopened before the primary examiner under 37 CFR 41.39(b)(1).

Extensions of time under 37 CFR 1.136(a) are not applicable to the TWO MONTH time period set forth above. See 37 CFR 1.136(b) for extensions of time to reply for patent applications and 37 CFR 1.550(c) for extensions of time to reply for ex parte reexamination proceedings.

Respectfully submitted,

Keith Walker

A Technology Center Director or designee must personally approve the new ground(s) of rejection set forth in section (9) above by signing below:

Greg Mills

PATRICK JOSEPH RYAN
SUPERVISORY PATENT EXAMINER

Conferees:

Patrick Ryan

Greg Mills